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Eastern European Equity Markets and the Subprime Crisis
Does Emerging Europe Still Offer Diversification Benefits?

Introduction

The rationale for international portfolio diversification is that it offers benefits beyond what can be gained through domestic investments. The idea is based on low or negative correlation between international securities returns. Early literature demonstrated that international diversification among developed markets rewarded investors with higher returns, as correlation between developed markets was low[1]. More recent studies, however, have more often emphasized the loss of diversification benefits among developed markets[2]. As a consequence, the focus has shifted to emerging economies, in which equity returns did not go in tandem with the Western world, and thus attract international investors. While the research on the existence of international diversification produced mixed results, there has been a general agreement on the fact that correlation between stock market prices increases during market downturns, reducing the benefits when they are mostly needed.[3] This contagion effect affects both developed and emerging markets. The developments on international equity markets since the outburst of the subprime bubble has confirmed the argument of increased correlation among global equity markets in economic downturns. Additionally, the enhanced integration of the economies of various countries due to increased globalisation has intensified the co-movement of their equity returns.

Research on diversification possibilities in Eastern Europe (EE) has been so far scarce. The reason is the relatively brief existence of its stock markets. Existing studies confirmed, however, the attractiveness of these markets to foreign investors. In an early analysis of Central and Eastern European markets Schroeder concluded that inclusion of some of their countries stock indices in an investment portfolio may offer important diversification potential.[4] Later, Gilmore and McManus confirmed the view of no long-term relationship between major equity markets in Central Europe and the USA.[5] This argument was supported by Platev and Kanaryan in a more recent analysis of four Eastern European markets: Russian, Czech, Hungarian and Polish.[6]

The global financial turmoil rocked all countries in Eastern Europe, yet not all with the same force. The entry in the EU of twelve Eastern European countries, together with the success in stabilising and reforming their economies, has resulted in increased economic and financial integration with Western Europe. This stimulated massive cash inflows to the new EU member states, in the form of FDI, bank loans, and portfolio investment. During the good times, it helped Emerging Europe to catch up with advanced economies. However, when the global economic climate deteriorated, the increased integration made EE more vulnerable to external global shocks. This vulnerability could quickly be observed in their equity markets, which followed the markets of Western Europe.

The aim of this paper is to analyse the developments in the stock markets of Eastern European countries before and during the subprime crisis and to evaluate the hypothesis of disappearing portfolio diversification opportunities in Eastern Europe. The paper concentrates on the stock markets of eleven EE countries: Bulgaria, Estonia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, Ro-

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[1] B.H. Solnik, *Why not diversify internationally rather than domestically?*, "Financial Analysts Journal", 1974, 30, H. Levy, M. Sarnat, *International diversification of investment portfolios*, "The American Economic Review", 1970, 60(4).

[2] R.A. Sinquefield, *Where are the gains from international diversification?*, "Financial Analysts Journal", 1996, 52(1), I. Meric, G. Meric, *Co-movements of European equity markets before and after the 1987 crash*, "Multinational Finance Journal", 1997, 2. Nonetheless, there are authors who argue that the benefits still exist, e.g. M. Statman, J. Scheid, *Global diversification*, 2004, available at Social Science Research Network.

[3] E.g. R.A.J. Campbell, C. S. Forbes, K.C.G. Koedijk, P. Kofman, *Diversification meltdown or just fat tails?*, EFA Zurich Meetings, 2006, available at Social Science Research Network.

[4] M. Schroeder, *Investments in CEE capital markets: Benefits from diversification and optimal portfolios,* in *The New Capital Markets in Central and Eastern Europe*, ed. M. Schroeder, Springer, Berlin 2001, 465-481.

[5] C.G. Gilmore, G.M. McManus, *International portfolio diversification: US and Central European equity markets*, "Emerging Markets Review", 2002.

[6] P. Platev, N. Kanaryan, *Stock market crises and portfolio diversification in Central and Eastern Europe*, "Managerial Finance", 2006, 32(5).

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mania, Russia, Slovenia, and Ukraine.[7] Their attractiveness in terms of diversification benefits will be assessed from the point of view of a US investor. Monthly equity index data in USD for each county was obtained from Morgan Stanley Capital Index except for Latvia and Lithuania whose indices come from NASDAQ OMX Baltic. The main period of analysis covers January 2003 to July 2009.

The paper is structured as follows: the next section provides an analysis of stock markets in EE before the crisis and a brief overview of macroeconomic fundamentals in the analysed countries, with an attempt to identify their potential vulnerabilities to external shocks. Section III concentrates on the impact of the crisis on Emerging European equity markets. Section IV explores diversification opportunities in EE and section V concludes.

Through the application of correlation analysis, Markowitz mean variance approach and portfolio optimisation strategy based on maximisation of excess return to volatility ratio it is shown that diversification opportunities for a US investor in the Eastern European region have largely disappeared.

Equity markets in Eastern Europe

Previous studies found that a stock market's vulnerability to a crisis depends on various factors. This section analyses the stock markets in EE with an attempt to isolate individual countries' vulnerabilities within three areas: stock market development, economic fundamentals, and sensitivity to worldwide market movements.

➢ **Stock market development**

Equity markets in Eastern Europe, which had to be built from scratch at the beginning of the last decade, afterwards grew rapidly. Even though the banking sector remains the main source of finance in this region, the importance of the stock market has grown significantly. The rapid growth paired with reforms in the financial sector drew in foreign investors who were rewarded with attractive and stable rates of return for accepting higher risk. However, due to globalisation of financial markets, the equity markets of the EE region were not able to withstand the collapse of global stock market indices in the second half of 2007 (even though their economies were quite resistant at the beginning).

Figure 1 shows the development of selected global equity market indices from January 1997 until July 2009. Interestingly, the MSCI index of Eastern European Emerging markets (EMEE) - just as the Emerging Markets (EM) Index covering emerging economies in other parts of the world - moved in the opposite direction to developed market indices and the World index at the end of the 1990s. This could explain previous research findings in support of the diversification benefits in EE. This trend, however, changed at the beginning of this century, since when the EMEE index has gone in tandem with the developed world. Another important observation is that the fall of the EMEE index in the crisis was much more severe than the losses of the main world exchanges. There are several reasons for this. At the beginning, the decline of Eastern European stock markets was more a reaction to the behaviour of world stock markets. But it also resulted from the deteriorating financial situation of international investors present in the region, who were very often forced to leave the market in order to improve their current liquidity. Finally, the deteriorating prospects for EE countries in view of the global crisis played their role.[8]

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[7] The countries will be referred to as Eastern European (EE) or Emerging European interchangeably in the text. The term "Emerging Europe" in the study will cover all the analysed countries, even though countries like Romania, Ukraine and Bulgaria are often referred to as frontier markets (MSCI Barra).

[8] PricewaterhouseCoopers, *Kryzys na rynkach finansowych. Wyzwania stojace przed spolkami*, PWC, 2009.

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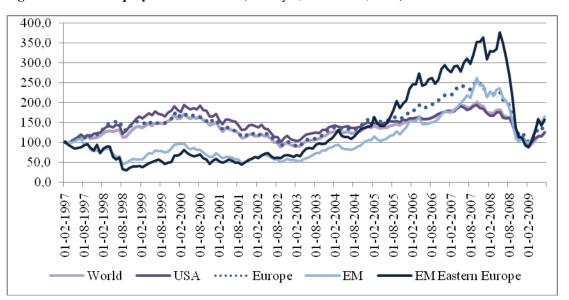Ul. Sucharskiego 2
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Figure 1. Selected Equity Market Indices (January 1, 1997 = 100, USD).

Source: MSCI Barra.
Note: EM – Emerging Markets.

The economic slowdown and the withdrawal of foreign capital resulted in declines in market capitalisation of local companies. Table 1 provides information about the size of the individual markets in 2007 and 2008. Germany, the UK, and the US were added for purpose of comparison.

Table 1. Size of Eastern European Stock Markets.

Exchange	Market Capitalisation (EUR millions)		Number of listed companies			
			2007		2008	
	2007	2008	Number of IPOs	Total number of listed companies	Number of IPOs	Total number of listed companies
Eastern Europe						
Bucharest SE	21,523.88	6,474.07	0	54	2	64
Budapest SE	31,527.90	13,325.60	1	41	2	43
Bulgarian SE	14,820.75	6,371.03	9	369	7	399
Ljubljana SE	19,740.12	8,468.42	0	87	0	84
Prague SE	47,987.44	29,615.12	2	32	1	29
Warsaw SE	144,323.31	65,177.59	105	375	93	458
NASDAQ OMX Tallin	4,105.37	1,403.21	n.a.	18	n.a.	18
NASDAQ OMX Riga	2,098.48	1,166.43	n.a.	41	n.a.	35
NASDAQ OMX Vilnius	6,891.85	2,607.85	n.a.	40	n.a.	n.a.
Russian SE	1,021,145.67	281,801.34	n.a.	328	n.a.	314
Ukrainian SE	75,927.71	17,282.00	n.a.	276	n.a.	251
Advanced economies						
Deutsche Börse	1,439,955.31	797,063.00	65	866	5	832
London SE	2,634,577.30	1,352,327.00	268	3,307	73	3,096
US	13,197,925.89	10,716,314.25	296	5,133	57	5,130

Source: FESE, World Bank, World Development Indicators: 2008, The World Bank, Washington 2008, World Bank, World Development Indicators: 2009, The World Bank, Washington 2009.

In 2007 most of the countries reached their highest levels in terms of market capitalisation. The leader in the region was Russia, where market capitalisation of €1.02 billion was approaching the level of Germany and Spain. It was followed by the Warsaw, Ukrainian and Prague stock exchanges. The financial crisis brought great declines in 2008. Then, Ukrainian, Russian, and Romanian stocks suffered most losing around 70% of their value compared to the previous year.

The global economic crisis and the loss of confidence in the capital markets had important implications for companies looking for capital. This was equally true in the USA as in European countries. European exchanges experienced a significant slowdown in the number of IPOs in 2008. According to PricewaterhouseCoopers, in 2008 a total of 337 companies decided to go public, which was a slump from 819 in 2007. The total value of IPOs fell by 83%. The same trend was in the volume and value of the US IPOs, which fell respectively by 81% and 60%.[9]

The Warsaw Stock Exchange, with 105 IPOs in 2007, was a definite leader in the EE region, even getting ahead of the German Stock Exchange. Even though the Polish stock market was hit badly by the crisis, it maintained its top position not only in Eastern Europe, but in Europe in general in 2008. In the same year, the Warsaw Stock Exchange was also leading in the region in terms of the number of companies listed, with a total of 458 companies. With the capitalisation of €65.18 billion, it outperformed such developed market exchanges as Vienna or Athens. In other countries of the region, IPOs were almost non-existent that year. The slowdown continued in the first half of 2009, when activity could be observed in only a few exchanges with Warsaw again at the top.

Even though EE stock markets have developed rapidly in recent years to relatively large sizes, their liquidity still lags behind the major developed markets. According to figure 2, Hungarian, Czech, Russian, and Polish markets were the ones with the greatest liquidity in the region in 2007. Even though they are still far away from British, American or German markets, they have already reached the size and/or liquidity of smaller European exchanges, like those of Vienna, Athens, or Lisbon. On the other hand, the Ukrainian, Latvian, Slovenian and Lithuanian stock exchanges can be described as the most illiquid.

Figure 2. Stock Market Capitalization vs. Turnover Ratio (2007).

Source: World Bank, World Development Indicators: 2008, ...op.cit.

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[9] PricewaterhouseCoopers, *IPO Watch Europe. Review of the year 2008*, PWC, 2009.

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> **Economic fundamentals**

Several studies confirmed that vulnerability of a country's stock market to a crisis depends not only on financial market development, but also on its economic fundamentals.[10] Table 2 gives an overview of selected macroeconomic indicators for the analysed countries.

Table 2. Selected Macroeconomic Indicators (2007).

	GDP growth (%)	M2 (annual % growth)	Inflation	Current account balance (% of GDP)	Domestic credit (% of GDP)	Real interest rate
Eastern Europe						
Bulgaria	6.2	31.3	5.7	-22.0	66.8	2.0
Czech Republic	6.6	12.8	2.1	-1.8	47.7	2.1
Estonia	6.3	13.6	3.7	-18.0	96.1	-2.9
Hungary	1.1	9.5	5.5	-4.9	61.5	3.2
Latvia	10.3	13.5	5.1	-23.9	93.9	-2.1
Lithuania	8.8	21.7	1.6	-14.8	61.2	-1.6
Poland	6.6	13.0	2.3	-4.4	39.7	3.9
Romania	6.0	33.9	13.8	-13.9	35.8	2.3
Russia	8.1	44.2	12.9	5.9	39.0	-3.1
Slovenia	6.8	8.4	4.5	-4.9	79.0	1.7
Ukraine	7.6	50.8	8.5	-3.7	58.8	-6.5
Advanced economies						
Germany	2.5	n.a.	1.6	7.6	105.5	n.a
UK	3.0	15.9	2.8	-2.8	190.0	2.4
USA	2.0	12.1	2.7	-5.3	210.1	5.3

Source: EBRD, World Bank, World Development Indicators: 2008, ...op.cit.

The data reveals substantial differences in macroeconomic policies among EE countries. Indicators of overheating, such as large current account deficit, fast credit growth and high inflation, were visible in 2007 in the countries which subsequently were most affected by the crisis. The transition region has undergone a rapid expansion of the financial sector in recent years, which included high growth in lending at rates that were unsustainable. The funding of credit growth, and possible negative implications of the decline in such funding for GDP growth, could have been a cause for concern for foreign investors in Eastern Europe.[11] Many of the countries experienced serious problems with current account deficit (especially the Baltic countries, Romania and Bulgaria), financed largely by borrowing of subsidiaries of foreign banks from their parents. Relatively cheap foreign funding resulted in rapid credit growth especially in Ukraine, Russia and Romania. The same countries were struggling with inflation which amounted to 8.5%, 12.9%, and 13.8%, respectively. These countries could be the most vulnerable to the crisis and the decline in their stock prices could be the deepest. There were, however, countries where sound economic fundamentals could make their markets more

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[10] E. Fama, *Stock returns, real returns, inflation, and money*, "American Economic Review", 1981, 71, N. Chen, F. Zhang, *Correlations, trades and stock returns of the Pacific-Basin markets*, "Pacific-Basin Finance Journal", 1997, 5, International Monetary Fund, *Global Financial Stability Report: Financial stress and deleveraging. Microfinancial implications and policy*, IMF, Washington 2008, R.G. Bowman, K. F. Chan, M.R. Comer, *Contagion in world equity markets and the Asian economic crisis*, 2007, available at Social Science Research Network.

[11] International Monetary Fund, *Regional Economic Outlook: Europe. Addressing the crisis*, IMF, Washington 2009.

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resistant to the crisis. A striking example is the Czech Republic, with a low current account deficit, relatively low interest rates, and consequently foreign currency bank lending, and low inflation.

An additional determinant of international investment decision making could be the country risk. According to Euromoney Country Risk Poll, the safest places to invest within EE in September 2007 were Slovenia (26) and the Czech Republic (37).[12] Unstable political situations in Romania, Bulgaria, and Russia, as well as poor access to bank finance placed these countries at the bottom of the EE country risk list.

> **Sensitivity to worldwide market movements**

Previous research documents a relationship between a country's stock market returns in a crisis and the country's sensitivity to worldwide market movements.[13] According to Roll, the relative movement of each market in the crisis is the usual relation between the particular market and the worldwide factor that caused the crash. Thus, a more extreme reaction to the negative market shock should be expected in countries with high international co-movements.

In order to determine the co-movement of each of the analysed EE countries' equity returns with worldwide equity market returns, regression models were estimated. The time series of monthly returns on the World index was regressed on individual countries' monthly returns from January 2003 to October 2007. The beta coefficient in the model represents individual country beta and measures the sensitivity of a country's index returns to changes in the World index returns. The results for the analysed sample are mixed (see appendix 1). Only in five out of the eleven countries the change in the World index value was a significant determinant of a country's stock market returns. The values of the β coefficient, ranging from 2.03 to 1.21, show great sensitivity to worldwide market movements prior to the crisis in Poland, Hungary, the Czech Republic, Russia and Estonia. This can be explained by the higher degree of their capital markets' integration with the world and greater dependence of these countries on the rest of the world. Equity market returns in all the other countries were not significantly dependent on the world equity market returns. The percentage of variance in individual countries' returns explained by the changes in the World index is much lower in EE countries – from 44% in Poland to 15% in Russia - than in the USA, the UK or Europe (70-95%). This suggests still greater importance of country/ region specific variables for equity returns in the EE countries as compared to the Western world.

The impact of the crisis on Eastern European stock markets

Figure 1 has shown the immediate reaction of the EMEE index to changes on world stock exchanges in the recent crisis. This section will provide a closer look at the individual countries' reactions to the crisis.

Table 3 identifies peaks and troughs in the EE equity markets. Even though the duration of declines in individual markets was approximately the same, some differences between countries did exist. Moreover, it is noteworthy that the performance of the Emerging European stock markets before and during the crisis varied substantially from country to country. The US stock market index reached its highest level in October 2007, even though negative news from the banking sector had caused fluctuations already before that date. Bad news concerning subprime mortgage-backed securities came in February 2007 from HSBC. In July the CEOs of Merrill Lynch and the City Bank resigned and the Dow Jones index started falling. This caused an immediate reaction of several Eastern European indices, including Estonian, Hungarian, Romanian and Ukrainian. Most of the other EE markets followed them in subsequent months (after the fall of Northern Rock). The most resistant proved to be Russia and the Czech Republic. At the start of the global crisis it seemed that Russia would be a safe haven. Its stock market was growing rapidly, reaching its peak in May 2008. At the

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[12] Euromoney. Country risk poll September 2007: Positive feeling, "Euromoney", September 2007.
[13] R. Roll, *The international crash of October 1987*, "Financial Analysts Journal", 1988, 44. R.G. Bowman, K. F. Chan, M.R. Comer, *Contagion...*, op.cit.

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beginning of 2008 the effects of the crisis were already visible in the country. In the first quarter of the year it suffered a net capital outflow of $22.08 billion, which reversed the $20.8 billion inflow in the fourth quarter of 2007.[14] Certainly, there were several factors leading to the stock market crash in Russia. Yet, one of them was also the reason why Russia resisted so long. It was the country's reliance on oil.[15] Falling oil prices, among others, drove the Russian equity market down in June 2008 showing the country's vulnerability to external economic shocks.

Table 3. Stock Markets' Peaks and Troughs.

Markets	Peak to trough	Index change		
		Before crisis	Peak to trough	Trough to current
Eastern Europe				
Bulgaria	Oct. 2007-Feb.2009	66.52%	-88.88%	48.62%
Czech Republic	Jun. 2008- Feb.2009	714.61%	-64.63%	81.12%
Estonia	Jul. 2007-Nov. 2008	338.31%	-77.08%	12.01%
Hungary	Jul. 2007- Feb. 2009	371.41%	-78.10%	121.12%
Latvia	Sep. 2007-Feb. 2009	246.17%	-74.03%	32.99%
Lithuania	Oct. 2007-Feb. 2009	761.22%	-74.59%	30.51%
Poland	Oct. 2007-Feb.2009	392.44%	-76.30%	95.77%
Romania	Jul. 2007-Feb. 2009	105.68%	-88.58%	143.36%
Russia	May 2008-Feb. 2009	529.70%	-78.44%	75.78%
Slovenia	Dec. 2007-Feb. 2009	429.77%	-67.27%	39.01%
Ukraine	Jul. 2007-Feb. 2009	14.03%	-89.51%	70.32%
Advanced economies				
USA	Oct. 2007-Feb. 2009	82.48%	-52.22%	34.06%
UK	Oct. 2007-Feb. 2009	136.44%	-61.29%	40.70%
Germany	Oct. 2007-Feb. 2009	255.90%	-61.59%	48.54%

Source: MSCI Barra, NASDAQ OMX Baltic.
Note: Peak is defined as the month when the index reached its highest level, trough when it reached the lowest level. The period of analysis is 31.01.2003-30.06.2009, except for: Bulgaria, Romania and Ukraine for which the data starts on 30.06.2005, 30.12.2005, and 30.06.2006, respectively.

The case of the Czech Republic is much different from that of Russia. Because of low interest rates the incentive to seek out foreign currency loans was much weaker in the country. It had a balanced financial system financed by deposits rather than by foreign funds. This helped the Czech market to defend itself against negative news from the world financial markets for a very long time. Interestingly, not only was the duration of the crisis the shortest in the Czech Republic, but also the price drop of 64% from peak to trough was the most shallow in the region and comparable with what Western countries experienced. This confirms the argument put forward in the previous section, that the countries with greater economic strength should suffer less.

All of the analysed countries in the EE region enjoyed a period of substantial equity price increases until the global crisis reached their markets. At their peaks Czech and Lithuanian stocks were worth seven times more than in January 2003. At the same time, US and UK equities had grown by only 82% and 136%. High rates of return had attracted more and more international investors before the global equity market slump. Yet, when the crisis hit Eastern Europe, investors in the region were also hit harder than the ones with portfolios in developed countries of Western Europe or America. While the latter experienced a 50-60% decrease in equity prices (from peak to trough), price falls in Bulgaria, Romania and Ukraine amounted to almost 90% of their peak values. The size of declines

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[14] P. Lee, *The credit crunch heads East: Russian banks prepare for a battle*, "Euromoney", 2 May 2008.
[15] P. Lesova, *Russia's financial crisis is getting worse*, "Market Watch", 12 November 2008, http://www.marketwatch.com/story/russias-financial-crisis-is-getting-worse.

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also results from overheating of the countries stock markets. The marginal contribution of domestic players to the stock market in Romania, for example, makes it dependent on the evolutions on the international markets. Political instability, the withdrawal of investors and great reliance on external funding to support domestic borrowing were the major factors that dragged the Ukrainian index down. Looking at the data until the end of July 2009 it seems that equity markets have rebounded from their troughs in February 2009 and have followed an upward trend since then. It means that investors are starting to come back to the region, which again offers higher returns than the Western markets. So far, indices have gained most in Romania, Hungary and Poland, while the equity markets in the Baltic countries, whose economies are struggling with deep recessions, have gone up only marginally.

Diversification benefits

In order to analyse diversification opportunities for a US investor in the Eastern European region, correlation coefficients with the US index were computed. Finally, through the application of portfolio theory, an attempt of identification of an optimum portfolio was made.

> **Correlations with the USA**

Pearson correlation coefficients of USD monthly returns for the 11 EE countries, the World index, EMEE index, the USA, and Europe are presented in appendix 2. Panel A presents correlation coefficients among the countries during the whole period of analysis. The table shows that significant and very high correlations existed among all of the analysed countries. From the perspective of a US investor, correlation was the lowest with Slovenian (0.52), Latvian (0.56), and Lithuanian (0.57) stock markets. It is also worth mentioning that the correlations were generally stronger between the US and Europe (0.92) than between the US and the individual EE markets. Appendix 3 plots the returns vs. standard deviations of returns in the analysed countries for the whole period. It shows that the EMEE portfolio does not dominate the other portfolios, while the Czech seems to be the dominant one. It had the highest returns and relatively low standard deviation as compared to other EE indices.

As mentioned before, previous research documented that correlations between global stock market returns increase over time and are higher during crises. In panel B correlations before the crisis, i.e. January 2003 to October 2007, are presented, and panel C contains correlation coefficients for the period from November 2007 to July 2009. A comparison of panels B and C clearly supports the findings of previous studies. Before the crisis, among all the correlation coefficients merely five were greater than 0.70 (correlations among USA, Europe and World, as well as correlations between EMEE and Russia and Poland). Only the returns on Polish, Czech, Estonian and Hungarian equities were significantly correlated with US returns, with the relationship being medium to low. The crisis changed the situation dramatically. The correlations increased significantly not only for the US vs. EE countries but also among the countries in Eastern Europe. This is consistent with previous studies that found correlations between markets increasing during crises.[16] The high correlation coefficients suggest that while in the period of high growth on EE stock markets they could offer potential diversification benefits for US investors, those benefits largely disappeared with the outbreak of the subprime mortgage crisis. This can be supported by figures in appendices 4 and 5. Appendix 4 proves that countries like the Czech Republic, Lithuania or Slovenia offered much greater returns to investors than the developed world markets. Not surprisingly, the risk level of those investments was significantly higher. Still they could have been attractive for investors willing to accept the risk. Appendix 5 shows how the situation changed during the crisis. Most of the EE indices (except for the Czech Republic and Hungary) experienced much higher losses than the World or US indices and at the same time their standard deviations were significantly higher. Moreover, the risk-return relationship of the Eastern European countries from November 2007 to July 2009 was negative. This confirms the "flight to quality" effect associated with the subprime crisis due to preference of foreign investors to invest in

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[16] Mateus found that correlations of equity returns in the new EU member states were increasing particularly since they were declared on the "fast track" to the EU. T. Mateus, *The risk and predictability of equity returns of the EU accession countries*, "Emerging Markets Review", 2004, 5.

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safer developed markets at turbulent time periods.[17] Overall, the high correlation of capital markets in Eastern Europe with the developed world is the evidence of increased financial integration and improved financial liberalisation in EE.

> ### ➢ Finding the optimum portfolio

The last part of the analysis focuses on the identification of potential gains for a US investor from investments in Emerging Europe. Two strategies are considered: the minimum variance portfolio and the optimum portfolio. Based on previous conclusions concerning increased correlation of the stock market returns in EE and the developed world, the hypothesis that diversification benefits for US investors in EE have disappeared will be tested.

First, the Markowitz model was applied to identify the portfolio with the lowest anticipated risk (global minimum portfolio). Excluding short sales, this portfolio can be calculated by solving the following constrained optimisation procedure:

$$\min Var(R_p) = \sum_{i=1}^{N}\sum_{j=1}^{N} x_i x_j Cov(R_i R_j)$$

subject to the constraint:

$$\sum_{i=1}^{N} x_i = 1, \qquad (x_i \geq 0, i = 1,2,...,N)$$

where $Var(R_p)$ is the variance of portfolio returns, $Cov(R_i,R_j)$ is the covariance of returns on index i and j, and x_i, x_j are portfolio weights.

In the optimisation procedure the expected return was calculated using the Capital Asset Pricing Model, where the return on one-month Treasury bills was used as the risk free rate and the monthly risk premium of 0.43% was assumed. Table 4 reports the results from the Markowitz mean variance optimisation. It confirms that EE countries offer low diversification opportunities for US investors. The identified global minimum portfolio suggests that a risk-averse investor would have to invest 94.06% in US stocks, 3.4% and 2.54% in Latvian and Slovenian equities, respectively. This results from the very high correlation coefficients with the US for all of the EE countries, with Latvia and Slovenia having the lowest values and relatively low volatility.

Table 4. Weights for Minimum Variance Portfolio and Optimal Portfolio.

	Weights	Portfolio return	Portfolio risk	Return/ Standard deviation
Global Minimum Portfolio				
Latvia	3.40%	0.53%	4.25	12.49%
Slovenia	2.54%			
USA	94.06%			
Optimum Portfolio				
Latvia	3.03%	0.54%	4.35%	12.52%
Slovenia	2.45%			
USA	66.34%			
World	28.17%			

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[17] J.F. Koeke, *Institutional investment in Central and Eastern Europe: investment criteria of Western portfolio managers*, ZEW Discussion Paper no. 99-37, Mannheim 1999, T. Mateus, *The risk and predictability..., op.cit.*

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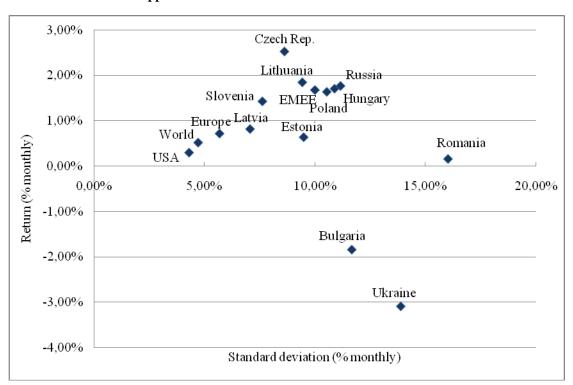Ul. Sucharskiego 2
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In the second step, the composition of the portfolio with the greatest ratio of excess return to standard deviation (Sharpe ratio) was investigated. The strategy of selecting the portfolio which maximises the anticipated Sharpe ratio can be viewed as an aggressive strategy as compared to minimum variance portfolio. This tangency portfolio can be identified using the following maximisation procedure:

$$\max S(x) = \frac{\sum_{i=1}^{N} x_i \left[E(R_i) - \overline{r_f} \right]}{\sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} x_i x_j Cov(R_i, R_j)}}$$

subject to the constraint:

$$\sum_{i=1}^{N} x_i = 1, \qquad (x_i \geq 0, i = 1, 2, ..., N),$$

where S represents the Sharpe ratio and r_f is the risk-free rate of return.

The identified tangency portfolio is very close to the minimum variance portfolio in terms of expected return and volatility. This time the World index was included with 28.17% share, together with a small portion of Latvian (3.03%) and Slovenian (2.45%) shares. This result implies that US investors with a more aggressive investment strategy should rather diversify through investments in the World portfolio than through including equity indices from EE countries. This supports the hypothesis of disappearing diversification benefits in the region and is contrary to the findings of previous studies in the region. The results suggest that, on the one hand, the stock markets of the analysed countries have become more closely integrated with their Western neighbours, on the other, there is still a much higher level of risk related to equity investments in Emerging Europe.

Conclusions

The study provided an overview of the current developments on the stock markets of Eastern European countries with an attempt to investigate diversification opportunities for US investors in the region. The analysis leads to several conclusions.

It is evident that Emerging Europe is not a homogenous region. There are clear differences between individual countries' levels of stock market development and macroeconomic fundamentals. The equity markets in Poland, the Czech Republic and Hungary can be considered as leaders in the region in terms of size and liquidity. New EU member states and non-EU countries still need time and reforms to catch up with the rest of the group. To improve their resilience to external shocks they need to foster deeper and more liquid markets with diverse institutional investors, both domestic and foreign. Additionally, the stock markets of the latter group, i.e. Romania, Bulgaria, Russia and Ukraine, were more vulnerable to the crisis due to poor economic fundamentals – high inflation, rapid credit growth or large current account deficits. This reveals the need to readdress the macroeconomic policies in the countries where the problems are most severe.

The analysed stock markets in EE went through a period of rapid growth, especially after the accession of most of them to the EU. Joining the EU they had to integrate with Western Europe on various levels, which had important implications for their equity price development during the subprime mortgage crisis. From January 2003 until July 2009 equity returns on all of the analysed markets were significantly and strongly correlated with the returns on the US stock index. Finally, the application of the mean variance approach and the optimum portfolio strategy has revealed that Eastern Europe does not provide much diversification from the point of view of a US investor. Apparently, the returns on US stocks are much less risky than returns from the analysed Emerging markets.

Investors looking for the highest reward to volatility would be better off investing in the World portfolio than in Eastern Europe.

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Appendix

Appendix 1. Average Monthly Returns and Market Regression Results (January 2003-October 2007).

Country	Sample size	Average return (% monthly)	Standard deviation (% monthly)	Slope (β)	T	Adj. R^2
Eastern Europe						
Bulgaria	29	0.019	0.049	0.518	1.185	0.014
Czech Rep.	57	0.037	0.062	1.477	5.623	0.353
Estonia	57	0.025	0.067	1.211	3.836	0.197
Hungary	57	0.030	0.077	1.580	4.518	0.257
Latvia	57	0.027	0.050	0.588	2.332	0.073
Lithuania	57	0.041	0.071	0.768	2.101	0.057
Poland	57	0.031	0.077	2.031	6.667	0.437
Romania	22	0.033	0.082	0.893	1.095	0.009
Russia	57	0.034	0.080	1.307	3.341	0.154
Slovenia	57	0.030	0.058	0.465	1.548	0.024
Ukraine	16	0.006	0.069	0.731	0.795	-0.023
Other Indices						
USA	57	0.011	0.024	0.892	20.129	0.878
UK	57	0.016	0.029	0.987	11.966	0.717
Europe	57	0.018	0.033	1.176	38.821	0.951
EMEE	57	0.032	0.067	1.509	5.081	0.307
World	57	0.014	0.025			

Note: The period of analysis is 31.01.2003-30.06.2009, except for: Bulgaria, Romania and Ukraine for which the data starts on 30.06.2005, 30.12.2005, and 30.06.2006, respectively.

Appendix 2. Correlations.

	BG	CZ	EST	H	LV	LT	PL	RO	RUS	SLO	UA	USA	World	Europe	EMEE
Panel A: whole period															
BG	1	.794**	.725**	.741**	.629**	.749**	.711**	.764**	.742**	.704**	.761**	.783**	.829**	.847**	.791**
CZ	.794**	1	.586**	.810**	.596**	.595**	.830**	.817**	.690**	.448**	.685**	.735**	.798**	.807**	.816**
EST	.725**	.586**	1	.617**	.515**	.749**	.523**	.552**	.577**	.534**	.713**	.613**	.671**	.675**	.641**
H	.741**	.810**	.617**	1	.591**	.576**	.830**	.808**	.682**	.577**	.710**	.751**	.810**	.813**	.816**
LV	.629**	.596**	.515**	.591**	1	.744**	.600**	.593**	.500**	.486**	.641**	.562**	.612**	.594**	.573**
LT	.749**	.595**	.749**	.576**	.744**	1	.515**	.499**	.555**	.536**	.729**	.574**	.636**	.646**	.604**
PL	.711**	.830**	.523**	.830**	.600**	.515**	1	.777**	.608**	.403**	.589**	.770**	.810**	.805**	.767**
RO	.764**	.817**	.552**	.808**	.593**	.499**	.777**	1	.739**	.514**	.666**	.776**	.809**	.813**	.802**
RUS	.742**	.690**	.577**	.682**	.500**	.555**	.608**	.739**	1	.485**	.818**	.609**	.699**	.700**	.968**
SLO	.704**	.448**	.534**	.577**	.486**	.536**	.403**	.514**	.485**	1	.713**	.520**	.572**	.593**	.526**
UA	.761**	.685**	.713**	.710**	.641**	.729**	.589**	.666**	.818**	.713**	1	.699**	.774**	.785**	.820**
USA	.783**	.735**	.613**	.751**	.562**	.574**	.770**	.776**	.609**	.520**	.699**	1	.973**	.920**	.714**
World	.829**	.798**	.671**	.810**	.612**	.636**	.810**	.809**	.699**	.572**	.774**	.973**	1	.976**	.801**
Europe	.847**	.807**	.675**	.813**	.594**	.646**	.805**	.813**	.700**	.593**	.785**	.920**	.976**	1	.804**
EMEE	.791**	.816**	.641**	.816**	.573**	.604**	.767**	.802**	.968**	.526**	.820**	.714**	.801**	.804**	1

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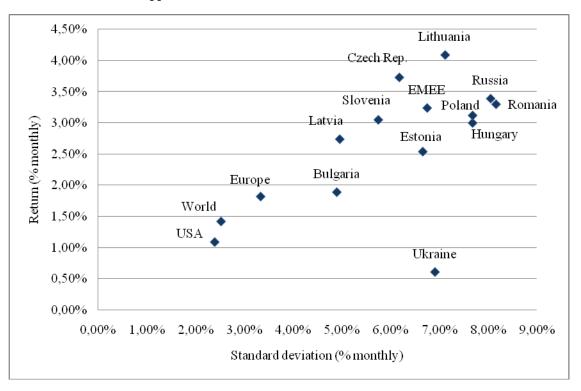| Panel B: before crisis														
	BG	CZ	EST	H	LV	LT	PL	RO	RUS	SLO	UA	USA	World	Europe	EMEE
BG	1	.198	.266	.290	.077	.181	.264	.495*	.191	.510**	.151	.079	.222	.345	.240
CZ	.198	1	.402**	.677**	.331*	.312*	.683**	.372	.492**	.144	.104	.456**	.604**	.620**	.687**
EST	.266	.402**	1	.501**	.488**	.556**	.445**	.305	.239	.248	.404	.401**	.459**	.430**	.377**
H	.290	.677**	.501**	1	.370*	.297*	.694**	.465*	.453**	.272*	-.052	.388**	.520**	.544**	.682**
LV	.077	.331*	.488**	.370**	1	.675**	.370**	.120	.293*	.136	.101	.188	.300*	.244	.372**
LT	.181	.312*	.556**	.297	.675**	1	.240	-.132	.275*	.117	.150	.176	.273*	.302*	.323*
PL	.264	.683**	.445**	.694**	.370*	.240	1	.380	.480**	.130	.179	.544**	.669**	.632**	.719**
RO	.495*	.372	.305	.465*	.120	-.132	.380	1	.524*	.264	.046	.104	.232	.282	.520*
RUS	.191	.492**	.239	.453**	.293*	.275*	.480**	.524*	1	-.025	.131	.234	.411**	.396**	.938**
SLO	.510**	.144	.248	.272*	.136	.117	.130	.264	-.025	1	-.145	.184	.204	.265*	.050
UA	.151	.104	.404	-.052	.101	.150	.179	.046	.131	-.145	1	.045	.201	.279	.135
USA	.079	.456**	.401**	.388**	.188	.176	.544**	.104	.234	.184	.045	1	.938**	.823**	.374**
World	.222	.604**	.459**	.520**	.300*	.273*	.669**	.232	.411**	.204	.201	.938**	1	.937**	.565**
Europe	.345	.620**	.430**	.544**	.244	.302*	.632**	.282	.396**	.265*	.279	.823**	.937**	1	.555**
EMEE	.240	.687**	.377**	.682**	.372*	.323*	.719**	.520*	.938**	.050	.135	.374**	.565**	.555**	1
Panel C: during crisis														
	BG	CZ	EST	H	LV	LT	PL	RO	RUS	SLO	UA	USA	World	Europe	EMEE
BG	1	.903**	.812**	.843**	.692**	.861**	.787**	.797**	.832**	.713**	.808**	.848**	.880**	.888**	.881**
CZ	.903**	1	.656**	.880**	.740**	.766**	.913**	.884**	.791**	.602**	.729**	.852**	.883**	.892**	.876**
EST	.812**	.656**	1	.658**	.393	.846**	.514*	.585**	.747**	.649**	.753**	.660**	.726**	.750**	.753**
H	.843**	.880**	.658**	1	.721**	.755**	.906**	.868**	.803**	.767**	.805**	.908**	.941**	.942**	.882**
LV	.692**	.740**	.393	.721**	1	.704**	.722**	.689**	.569**	.610**	.682**	.679**	.704**	.707**	.640**
LT	.861**	.766**	.846**	.755**	.704**	1	.666**	.586**	.712**	.784**	.786**	.739**	.790**	.802**	.751**
PL	.787**	.913**	.514*	.906**	.722**	.666**	1	.847**	.656**	.529*	.620**	.872**	.878**	.888**	.775**
RO	.797**	.884**	.585**	.868**	.689**	.586**	.847**	1	.763**	.545*	.704**	.849**	.871**	.874**	.840**
RUS	.832**	.791**	.747**	.803**	.569**	.712**	.656**	.763**	1	.806**	.887**	.754**	.812**	.829**	.984**
SLO	.713**	.602**	.649**	.767**	.610**	.784**	.529*	.545*	.806**	1	.863**	.637**	.709**	.723**	.791**
UA	.808**	.729**	.753**	.805**	.682**	.786**	.620**	.704**	.887**	.863**	1	.741**	.809**	.817**	.887**
USA	.848**	.852**	.660**	.908**	.679**	.739**	.872**	.849**	.754**	.637**	.741**	1	.981**	.944**	.833**
World	.880**	.883**	.726**	.941**	.704**	.790**	.878**	.871**	.812**	.709**	.809**	.981**	1	.987**	.884**
Europe	.888**	.892**	.750**	.942**	.707**	.802**	.888**	.874**	.829**	.723**	.817**	.944**	.987**	1	.899**
EMEE	.881**	.876**	.753**	.882**	.640**	.751**	.775**	.840**	.984**	.791**	.887**	.833**	.884**	.899**	1

Note: * - correlation is significant at the 0.05 level; ** - correlation is significant at the 0.01 level.
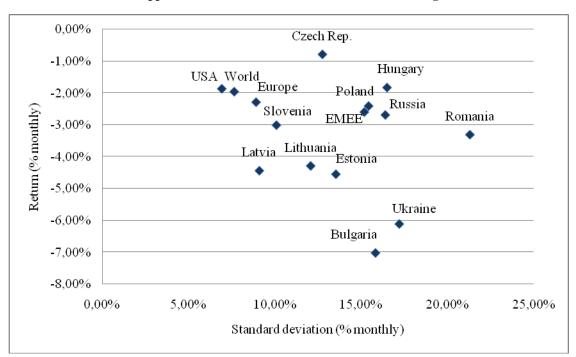
Appendix 3. Return vs. Standard Deviation – Whole Period.

Appendix 4. Return vs. Standard Deviation – Before Crisis.

Appendix 5. Return vs. Standard Deviation – During Crisis.